

Evaluation of the effects of malaria infection on serum lipid profile of patients attending two district hospitals in Enugu, Nigeria

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ABSTRACT

A longstanding myth exists among the Igbos in the South-East of Nigeria, which associates malaria symptoms with intake of fatty meals. The rapidly growing malaria parasite requires large amounts of lipids for increase in surface area and volume of its internal membranes. We hypothesized that certain serum lipid fractions may favour the onset and/or severity of malaria infection. Patients with clinically characterized frank malaria (n=30) attending two district hospitals were selected for this study. A corresponding number without any clinical or laboratory evidence of malaria infection was used as control. Serum lipid profile was determined in both malaria patients and control using standardized laboratory procedures. Presence of malaria parasite was confirmed by the thick blood film. Result showed a statistically significant difference between malaria patients and control in the HDL fraction only (P<0.05). This contrasted sharply with findings for the other serum lipid fractions. The HDL fraction may be implicated in the pathogenesis of malaria infection. Consequently, dietary habits may be playing a role in malaria onset and/or severity. We conclude that serum lipid lowering agents may be considered as part of the management protocol for treatment of malaria infection in the disease endemic zones.

Key words: Lipid lowering agents, lipid metabolism, lipid profile, lipid transport, malaria infection.

INTRODUCTION

On a global scale, malaria has been and remains a major public health concern¹. During intra-erythrocytic development, the human malaria parasite actively internalizes phospholipids from its erythrocyte membrane and the extracellular medium. The import of exogenous lipids is not due to endocytosis; but to energy dependent, trans-bilayer movement of phospholipids induced by the parasite in the erythrocyte surface². A study described newly elaborated carbon dense tubular and sheet-like structures that appeared to surround the malaria parasite and extend into the red cell cytosol. It has been suggested that these structures

were components of tubovacuolar network thought to be involved in lipid transport³. It appears that in plasmodium infected erythrocyte, lipid rafts may play a role in endovacuolation and macromolecular transport⁴. The parasitophorous vacuolar membrane lipids in plasmodium infected erythrocytes are derived from the host cells⁵. Some data strongly suggest that transport in infected erythrocyte can proceed via a classic Golgi secretory pathway⁶. Study has also shown that lipids do not cross the erythrocyte or parasitophorous vacuolar membrane, but gain direct access to the aqueous space surrounding the parasite through a parasitophorous duct⁷. Several parasite enzymes involved in lipid synthesis from glycerides and fatty

acids, as well as enzymes involved in remodeling of lipid polar head groups have been identified⁸. A better understanding of the parasite's lipid metabolism may lead to the development of novel therapeutic strategies, which exploit the uniqueness of the parasite. This study was aimed at characterizing the serum lipid profile of the malaria patients and sought to ascertain its role on the onset and/or severity of malaria infection.

MATERIAL AND METHODS

Patients with clinically characterized frank malaria attending two district hospitals in Enugu were selected for the study. A corresponding number without any clinical or laboratory evidence of malaria served as the control. Patients who are hypertensive, diabetics, suffering from nephrosis, liver disease or any condition suspected to affect serum lipids were excluded. Also excluded from

the study were participants who presented with fasting less than 12 hours before collection of blood samples. The age range of participants in the study varied from 10 to 60 years. Serum samples were collected and stored at 5°C in the presence of EDTA anti-coagulant; and values were read at wavelength of 500nm. Total Cholesterol fraction was determined by the enzymatic colorimetric method described by Allain *et al*⁹. Determination of triglyceride fraction carried out by the technique of Bucolo and David¹⁰. The determination of LDL and VLDL were carried out by salt fractionation technique. The HDL fraction was isolated from the other lipoproteins by the heparin manganese chloride precipitation method¹¹. Thick blood film using anti-coagulated (EDTA) venous blood was employed in the detection of malaria parasite. Data obtained were statistically analyzed using Student *t*-test, assuming $P < 0.05$ as significant; and presented in tabular form.

Table 1: Mean value of serum lipid fractions in malaria patients and control (mmol/l)

Lipid fraction	malaria patients	control	% change	p-value
Hdl	1.16± 0.06	0.88 ± 0.06	31.8%	0.0012*
Total cholesterol	5.1 ± 0.26	4.95 ± 0.19	3%	0.7208**
Ldl	3.21± 0.25	3.1 ± 0.21	3.6%	0.8868**
Triglycerides	1.4 ± 0.08	1.31 + 0.05	6.9%	0.3344**
Vldl	0.69± 0.04	0.77±0.04	-10.4%	0.1261**

* $P < 0.05$ (statistically significant)

** $P > 0.05$ (not statistically significant)

RESULTS

The mean HDL value was significantly increased by 31.8% from 0.88±0.06mmol/L to 1.16±0.06mmol/L in malaria patients relative to control. The mean total cholesterol was elevated by 3% in malaria patients relative to control from 4.95±0.19mmol/L to 5.1±0.26mmol/L. The mean LDL was elevated by 3.6% in malaria patients relative to control from 3.1±0.21mmol/L to 3.21±0.25mmol/L. In the triglyceride fraction, the mean value increased by 6.9% in malaria patients relative to control from 1.31±0.05mmol/L to 1.4±0.08mmol/L. However, the mean VLDL value

decreased by 10.4% in malaria patients relative to control from 0.77±0.04mmol/L to 0.69±0.04mmol/L.

DISCUSSION

It has been shown that the blood stage *Plasmodium falciparum* organisms accumulate a high mass of triacylglycerol and diacylglycerol¹². This huge demand for lipids provides an attractive target for novel anti-malarial drugs and several potential drugs targeting lipid metabolism have been identified⁸. It is shown, that there is a statistically significant difference ($P < 0.05$) between malaria patients and control in the HDL fraction. The HDL

fraction may be implicated in the pathogenesis of malaria infection. It has been reported that several intra-erythrocytic growth cycles of *Plasmodium falciparum* could be achieved *in vitro* using a serum free medium supplemented with a high density lipoprotein¹³. However, there was no statistically significant difference between malaria patients and control in other serum lipid fractions. The mean HDL value in control given as 0.88 ± 0.06 mmol/L increased significantly to 1.16 ± 0.06 mmol/L in malaria patients. There were no statistically significant differences in levels of other lipoprotein fractions between malaria patients and control. The mean total cholesterol value of 4.95 ± 0.19 mmol/L in control increases to 5.1 ± 0.26 mmol/L in malaria patients. A study suggested that cholesterol esters, a second neutral lipid species reported to be important for a related apicomplexan, *Toxoplasma gondii* was not essential for intra-erythrocytic plasmodium growths. In the LDL fraction, the mean LDL value of 3.21 ± 0.25 mmol/L in the test compares closely with 3.1 ± 0.21 mmol/L obtained in the control. However, in the VLDL fraction, there is a noticeable variation as the mean VLDL value of 0.77 ± 0.04 mmol/L in the control declines to

0.69 ± 0.04 mmol/L in malaria patients. Interestingly, it has been reported that parasite development was incomplete with the LDL fraction and did not occur at all with the VLDL fraction¹³. A study described functional and molecular characterization of the lipidic metabolism in plasmodium essential to membranal biogenesis of the parasite, leading to the conception of a new anti-malarial chemotherapy. However, a population-based study is recommended to further evaluate the effects of menopausal status, body mass index, hormonal use and energy expenditure on serum lipid profile during malaria infection. In conclusion, lipid-lowering drugs may be considered as part of the management protocol for treatment of malaria infection, especially in disease endemic zones such as Nigeria.

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